

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

PCM0016 – CHEMISTRY

(All sections / Groups)

14 OCTOBER 2019

9.00 a.m – 11.00 a.m

(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 4 pages only excluding the cover page.
2. Attempt **ALL** questions. Distribution of the marks for each question is given.
3. Please write all your answers in the answer booklet provided.

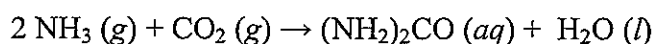
QUESTION 1 [15 MARKS]

- (a) Complete the table below by writing the chemical formulae, naming the compounds and identify the compounds as ionic or covalent:

Chemical formula	Name of compound	Ionic or covalent?
CCl_4	(i)	(ii)
(iii)	Magnesium oxide	(iv)

[2 marks]

- (b) The reaction of ammonia with carbon dioxide produces urea as shown in the equation below:



If a 15.87 g sample of ammonia was allowed to react with 25.36 g of carbon dioxide, determine the:

[Atomic mass: N = 14.0; H = 1.0; C = 12.0; O = 16.0; N = 14.0]

- (i) limiting reagent. [2 marks]
(ii) mass of urea formed at the end of the reaction. [1 mark]
(iii) amount of excess reagent left at the end of the reaction. [1 mark]

- (c) For the following statements, state whether it is true or false.

Statement	True/ False
Theoretical yield is the amount of product that would result if the entire limiting reagent reacted.	(i)
Compounds that have specific number of water attached to them are called anhydrous compounds.	(ii)

[1 mark]

- (d) What does the second quantum number (designated by the letter l) called and what does that quantum number describe? [1.5 marks]
(e) Write the ground state electron configuration for cobalt, ^{27}Co . Then identify the group and period in the periodic table. [2 marks]
(f) Explain the principles that you use to write the configuration of an atom. [3 marks]
(g) Give all the four sets of quantum numbers (n, l, m_l, m_s) for the highest energy electron that has the valence configuration of $3s^2 3p^4$. [1.5 marks]

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QUESTION 2 [15 MARKS]

- (a) In the molecules of NH_3 and H_2O , the obtuse (greater than 90°) bond angles are given below:

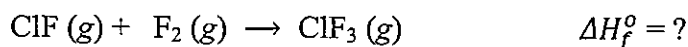
Bond	$\angle\text{H-N-H}$	$\angle\text{H-O-H}$
Bond angle	107°	x

- (i) Draw the Lewis diagram and predict the VSEPR geometry of both NH_3 and H_2O . [3 marks]
- (ii) Predict the value of x . [0.5 mark]
- (b) Using appropriate diagram, briefly discuss the polarity of water. [1.5 marks]
- (c) State the hybridization state of all carbon atoms in CH_3CHCH_2 . Also, calculate the number of sigma and pi bonds present in the molecule. [2 marks]
- (d) When dissolved in water, 8.2 % of 0.2 M of HF solution is ionized.
- (i) Find the K_a value of the acid. [1.5 marks]
- (ii) Discuss why the ionization percentage is low. [1 mark]
- (e) Calculate the mass (in gram) of hydrochloric acid that should be used to prepare a stock solution of 5.8 M hydrochloric acid in 700 mL volumetric flask.
[Atomic mass: H = 1.0; Cl = 35.5] [2 marks]
- (f) Find the pOH of a 0.0038 M sulfuric acid (H_2SO_4) solution. [2 marks]
- (g) In an acid-base reaction, 30.00 mL hydroiodic acid solution was needed to neutralize 25 mL sodium hydroxide solution that has concentration of 0.01 M. In the reaction, 1 mole of acid reacted completely with 1 mole of base. Determine the concentration of hydroiodic acid. [1.5 marks]

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QUESTION 3 [15 MARKS]

- (a) Define Boyle's law and draw the graph to show its relationship. [3 marks]
- (b) A bulb with volume of 270 mL was vacuumed and then was filled with an unknown gas at STP. By assuming the gas is in ideal state condition, determine the number of moles of the unknown gas.
[The universal gas constant, $R = 0.0821 \text{ L.atm/mol.K}$] [1 mark]
- (c) Find the pressure for 15.5 moles of NH_3 confined in a 5.0 L container at 15°C by assuming:
[Molecular mass of NH_3 is 17 g/mol; the universal gas constant, $R = 0.0821 \text{ L.atm/mol.K}$, a and b values of NH_3 are $4.17 \text{ L}^2.\text{atm/mol}^2$ and 0.0371 L/mol respectively]
- (i) The gas in the ideal state. [1 mark]
(ii) The gas in the deviation state (van der waals). [2 marks]
- (d) Find the mass of water that will provide the same amount of heat when cooled from 84.0°C to 24.0°C , as the heat provided when 100 g of steam is cooled from 110°C to 100°C .
[Specific heat of water = $4.186 \text{ J.g}^{-1}\text{C}^{-1}$; specific heat of steam = $1.864 \text{ J.g}^{-1}\text{C}^{-1}$] [2 marks]
- (e) (i) Explain Hess's law. [1 mark]
(ii) Use Hess's law to determine ΔH_f° for the formation of chlorine trifluoride:



Given:

Equations	ΔH_{rxn}° (kJ)
$2 \text{OF}_2(\text{g}) \rightarrow \text{O}_2(\text{g}) + 2 \text{F}_2(\text{g})$	-49.4
$2 \text{ClF}(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{Cl}_2\text{O}(\text{g}) + \text{OF}_2(\text{g})$	+205.6
$2 \text{ClF}_3(\text{g}) + 2 \text{O}_2(\text{g}) \rightarrow \text{Cl}_2\text{O}(\text{g}) + 3 \text{OF}_2(\text{g})$	+266.7

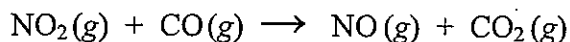
[3.5 marks]

- (iii) From your answer in (ii), calculate the amount of heat evolved per gram of $\text{ClF}_3(\text{g})$ produced. [Atomic mass: $\text{Cl} = 35.5$, $\text{F} = 19.0$] [1.5 marks]

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QUESTION 4 [15 MARKS]

- (a) Consider the following reaction between nitrogen dioxide and carbon monoxide.

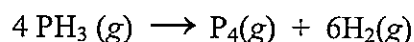


The initial rates of the reaction that were measured at different reactants' concentrations are listed in the table below.

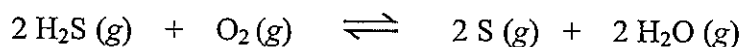
[NO ₂]	[CO]	Initial rate M/s
0.3	0.20	0.084
0.3	0.05	0.021
0.6	0.20	0.336

From the data, determine each of the following:

- (i) The rate law for the reaction. [2.5 marks]
 - (ii) The rate constant, k (and unit) for the reaction. [1.5 marks]
- (b) The thermal decomposition of phosphine (PH₃) into P₄ and H₂ is a first-order reaction. The half-life of the reaction is 35.0 s at 680 °C. Calculate the time required for 95% of the phosphine to decompose. [2 marks]



- (c) Referring to the reaction below:



- (i) Predict what will happen to the concentration of H₂O if small amount of O₂ is continuously supplied to the system. [1 mark]
 - (ii) Name and define the principle that you have applied in (i). [1 mark]
- (d) Corrosion is one example of an electrochemical process.
- (i) Draw a diagram to illustrate corrosion of metal. Label anode and cathode. [3 marks]
 - (ii) State two conditions that promote corrosion to occur. [1 mark]
 - (iii) Write half-equations at anode and cathode. [1.5 marks]
 - (iv) Briefly explain why corrosion is a redox reaction. [1.5 marks]

End of Paper